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EFFICIENCY IN THE DISTRIBUTION AND UTILIZATION OF HOSPITAL SERVICES: A CASE STUDY IN RURAL MICHIGAN

U.S. DEPARTMENT OF AGRICULTURE • ECONOMIC RESEARCH SERVICE • ERS - 492

ABSTRACT

A composite method is developed and used for regional analysis of the distribution and efficiency of general hospitals. The study area is the Grand Traverse Region, an eight-county rural area in Michigan. The region had approximately the correct number of hospital beds to handle current and expected needs. Average costs were constant, indicating no economies of scale. Lower short-run costs than in comparable hospitals elsewhere indicated relatively productive techniques. Greater rates of use of the larger hospitals indicated that patients discounted the higher prices of larger hospitals by implicit evaluations of the higher quality of care and number of services they offered.

Key words: Health facilities, rural health, multicounty area, regional planning, Michigan

PREFACE

The problem of rurality, poverty, and health is a circular one. In rural areas, incomes are generally lower and medical services generally poorer and less accessible than in urban areas. At the same time, the incidence of chronic illness, which limits work activity and thus reduces income, increases with both rurality and low-family income. Farmers in general experience a high rate of this type of illness. Also, the shortage of emergency services in rural areas is a definite contribution to the very high accident fatality rate in farming.

Quantitative and qualitative factors intensify the rural health care problem. Low incomes and sparse populations prevent rural areas from competing effectively in the medical marketplace; consequently, deficiencies exist in both the quantity and quality of rural-located medical personnel and facilities. Although general practitioners are evenly distributed by population density throughout the country, areas of high population density and high household incomes attract more specialists and hospital-based physicians. As a result, rural people often do not get the quality of care available in urban areas.

Thus, in terms of both need for medical care and availability of medical services, the rural poor are often deprived of even minimally adequate health care. Programs are underway or being planned that will help solve the problem. They include increasing the supply of services, reorganizing existing services and developing new ones on the basis of regional needs, and removing income and other barriers which impede the ability of the poor to obtain medical care. These efforts are based on a concern for the plight of disadvantaged Americans and an awareness that all Americans should have the opportunity to receive good health care.

To contribute to the search for solutions to inadequate medical care in rural areas, this report presents methods to measure efficiency in the distribution, costs, and utilization of hospital services. The methods are applied to general hospitals in an eight-county, rural-oriented area in the northwestern part of Michigan's lower peninsula.

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SUMMARY

General hospitals in Michigan's Grand Traverse Region operated as a reasonably efficient group in 1967, according to measurements of the distribution of their services and their costs and utilization.

The rural region's seven general hospitals had approximately the correct number of beds to handle current and expected needs at the minimum investment. To test the adequacy of bed numbers in terms of both service output and efficiency, actual 1967 numbers and hospital occupancy rates were compared with the number of beds that would be available under two alternative organizational structures. The alternatives considered the hospitals to be: (1) organized as seven autonomous units, each serving its own patients' needs, and (2) a group of fully cooperative hospitals fulfilling the function of one large hospital serving the entire region.

In addition, an appraisal was made of the subregional distribution of beds among four hospital service areas delineated in the 1968 Michigan State Plan for Hospital and Medical Facilities Construction. Although in some areas of the region, additional beds are needed to fulfill projected 1973 requirements, these needs can probably be met with existing facilities, provided there is sufficient cooperation among the hospitals.

A limited analysis of the hospitals' long-run average costs suggested that these costs were constant and equal to marginal costs. There seemed, therefore, no reason for concluding that fewer but larger facilities would provide services more economically than the existing hospitals.

Compared with average short-run costs in similar hospitals elsewhere, such costs in the region's hospitals were lower, indicating relatively efficient techniques. In 1967, the region's hospitals had approximately the same ratio of personnel to patients and the same length of patient stay as did hospitals in all of Michigan and the United States; but in the region, average costs, payroll per patient day, and average employee salaries were lower.

Finally, it was indicated that some of the higher total costs in the region's larger hospitals can be attributed to their ability to offer more and better services than do the smaller hospitals. This indication appears to be recognized by patients and doctors in the region because hospital occupancy rates increase with hospital size. Nevertheless, the smaller hospitals, by virtue of their geographic distribution and lower costs, were especially advantageous to the region's rural population.

EFFICIENCY IN THE DISTRIBUTION AND UTILIZATION OF HOSPITAL SERVICES: A CASE STUDY IN RURAL MICHICAN

by

Neville J. G. Doherty [1]

INTRODUCTION

A network of general hospitals is to a region what a single general hospital is to a community, the nucleus of the medical complex. Because of the rapidly rising cost of hospital care, one may legitimately query whether there are inefficiencies in the hospital system which create needless costs and, hence, wasted resources.

In recent years, several studies have indicated that inefficient internal and external organization of hospitals and hospital systems have contributed to the rising cost of medical care. Some of the major thrusts of these studies are summarized in the words of Walter Landgraff, who stated that:

> In the voluntary hospital, as in many other social and political institutions of a nonprofit nature where survival and productivity are not related to cost-efficiency factors, there has been no incentive or need to effect warrented changes in concept, organization, and operations; and to eliminate the expensive vestiges of past usefulness (1). [2]

In part, the problems mentioned by Landgraff resulted from decisions about hospital size and location which have been based on local aspirations and needs, while considerations regarding area needs or cooperation with other hospitals have often been treated indifferently. An unfortunate outcome is a national hospital network marked by excess facilities in some areas and shortages in others.

In rural areas, in particular, distance, low incomes, sparse populations, and interjurisdictional rivalries create special problems in providing adequate hospital care economically. These causes, however, are not completely general, being relatively severe in some areas and mild in others. Furthermore, within areas, there are different types of hospital care problems: for example, there may be sufficient hospital beds, but duplication or underutilization of hospital services may result in unnecessarily high costs; or costs may be low but the quality of care low, too. As a consequence, services that might feasibly be delivered efficiently to residents of a multicounty area by a single organization are frequently divided among several organizations.

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[1] The author is an Assistant Professor of Health Care Economics at the University of Connecticut Health Center. Material for this report was prepared while the author was an economist with the Economic Development Division, Economic Research Service, U.S. Dept. of Agriculture. The report is based on chapter 12 of The Economic Structure and Performance of the Medical Industry in Michigan's Grand Traverse Region (unpublished Ph.D. dissertation, Michigan State University, 1970).

[2] Underscored numbers in parentheses refer to references listed at the end of this report.

One objective of the study on which this report is based was to develop an approach for assessing distribution and cost efficiency problems of hospitals which could, almost systematically, be applied to any given region. Four methods for such an assessment will be discussed: First, a procedure is presented for evaluating the availability of hospital beds when several local hospitals work cooperatively as opposed to working independently of one another. Second, long-run average costs are analyzed to measure economies of scale. Third, procedures are presented for evaluating the efficiency of local hospitals in supplying medical services in terms of average short-run costs per patient day. Finally, the quantity and quality of a hospital's services are related to use of the hospital.

The rural-oriented study area, henceforth called the Grand Traverse Region, is composed of eight counties in the northwestern part of Michigan's lower peninsula (fig. 1). The counties (Antrim, Benzie, Crawford, Grand Traverse, Kalkaska, Leelanau, Missaukee, and Wexford) were selected because they are contiguous and form a readily identifiable geographic and economic region.

The region, with a population of 110,000 in 1970, depends on fruit farming and tourism for most of its economic activity. It also has some manufacturing in its largest towns, Traverse City and Cadillac. Traverse City is also the region's health services center. Two of the region's seven general hospitals, including an osteopathic hospital, as well as a State psychiatric hospital are located there. In general, the region evinces an air of prosperity, but behind this lie many typical rural problems: low incomes, high unemployment, high proportions of older people, and outmigration of the young.

Data in this report are for 1967, which, at the time of the study, was the latest year for which reliable data were available. Furthermore, 1967 saw completion of the first full year of the Medicare program and greatly increased participation in the Medicaid program. These programs have had a substantial impact on medical expenditures.

THE AVAILABILITY AND DISTRIBUTION OF HOSPITAL BEDS

The analytical approach used here is to test the actual 1967 distribution of hospital beds in the region against two alternatives: a statistically derived optimum, and the distribution suggested in the Michigan State Plan for Hospital and Medical Facilities Construction, 1968-69.

The statistically derived optimum distribution is based on the measure frequently employed to determine whether a hospital's size adequately provides for expected needs. This measure, the hospital's occupancy rate (OR), is defined as the ratio of beds used to beds available. It may vary according to changing demand conditions; yet it is usually regarded as fairly predictable. A 100-percent OR implies that all the beds in a hospital were being used every day over a given period, usually a year; a 50-percent rate implies that only half the bed capacity was used. In fact, hospitals rarely attain full occupancy. To permit

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The following change should be entered in the above report:

Page 12, paragraph 3, sentence 3
The sentence should read: Nevertheless increasing costs are not conformable with results of other findings, including Feldstein's, about hospitals in this size range.

TRAVERSE CITY HOSPITAL REGION, HOSPITAL SERVICE AREAS, AND LOCATION OF FACILITIES IN THE GRAND TRAVERSE REGION

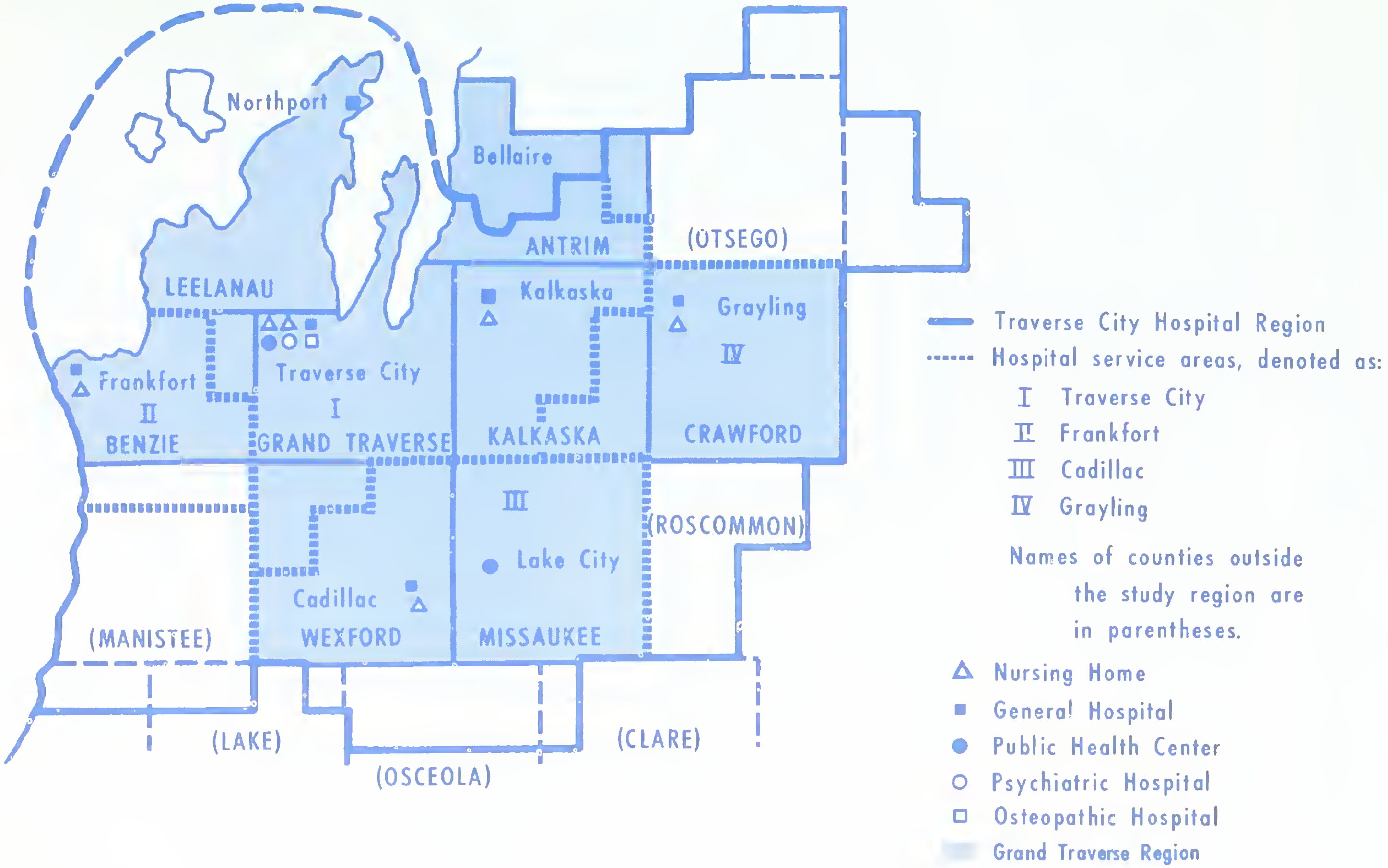

Figure 1

emergency accommodation, an 80-percent OR is usually regarded as a reasonable, normal capacity. 3/ A sustained higher rate could place a hospital into a "critically overcrowded" classification and could lead to the hospital obtaining a high-priority rating for expansion. In accordance with State and Federal guidelines, State and local authorities determine the desirable occupancy rates.

The essence of the State Plan approach is to distribute facilities of the right size to meet existing and expected demands in different geographic areas. These plans are prepared by each State according to Federal guidelines.

The distribution of beds in any geographic region can be analyzed in terms of three organizational structures: independent hospital requirements, total regional requirements, or subregional requirements. To achieve these structures in the study area, we can think of the region's seven hospitals organized as: (1) independent units, each serving its own patients' needs; (2) a group of cooperative hospitals serving the whole region (that is, seven hospitals working in such cooperation that they fulfill the function of one large hospital serving the entire region); and (3) subgroups of cooperating hospitals serving smaller areas.

The purpose of the analysis is to determine which organizational structure minimizes the number of hospital beds; and thereby to determine whether the hospital system could have been designed better, from the point of view of an equivalent output of services for a smaller investment. If an alternative to the present system is found to provide the same patient care with significantly fewer beds, then a misallocation of resources probably exists. But if the number of beds in the existing system is found to approximate some measure of optimality, the conclusion may be made that the hospitals were organized efficiently. As a first approximation, the performance of each hospital is rated by comparing the observed occupancy rates with the 80-percent rate frequently used as a norm. For this analysis, the region's hospitals are considered to function independently.

In 1967, occupancy rates in the five larger hospitals ranged from 78.6 to 85.0 percent; these are considered here to be close enough to 80 percent to represent normal, reasonable occupancy (table 1). The two smaller hospitals in Kalkaska and Leelanau had occupancy rates of 58.3 and 66.1 percent, respectively. For 80-percent rates in these hospitals, the number of beds should have been less

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3/ Hospital planners have traditionally regarded 80 percent as the optimum occupancy rate. Klarman has pointed out, however, that 85 percent is more in line with current thinking (2). The lower rate is used here because it appears to be more consistent with rates used by Michigan hospital planning authorities.

Table 1.--Service and economic data, Grand Traverse Region's general hospitals, 1967

Hospital location	Hospital beds	Patient days	Occupancy rate	Expenditures		Hospital personnel
				Total	Payroll	
	Number	Number	Percent	--1,000 dollars--		Number
Benzie..........	43	12,342	78.6	499	271	67
Crawford........	68	20,561	83.0	855	495	101
Grand Traverse:						
General.......	250	73,730	80.8	3,794	2,675	609
Osteopathic...	73	22,643	85.0	1,070	617	152
Kalkaska........	20	4,259	58.3	176	97	28
Leelanau........	29	6,995	66.1	279	153	40
Wexford.........	128	37,946	81.2	2,029	1,063	260
Total	611	178,476	80.0	8,702	5,371	1,257

Source: (3) and (4).

or the number of patients greater. Kalkaska's hospital, which had 20 beds and 4,259 patient days, needed only 15 beds to obtain the 80-percent OR; Leelanau's hospital, with 29 beds and 6,995 patient days, would have had an optimum rate with 24 beds. 4/

These criteria indicate that there were actually only 10 excess beds in the region in 1967, five in each of the two small hospitals in Kalkaska and Leelanau. These 10 excess beds are a small number from which to form conclusions about underutilization. As will be seen in the following sections, where cooperation among hospitals is discussed, patient transfers can be used to adjust a small differential such as this. 5/

4/ The optimum number of beds is calculated by converting patient days into an average daily census figure and dividing by .80:

$$\text{optimum number of beds} = \frac{\text{patient days}}{365} \div (.80).$$

5/ Large hospitals tend to offer more services than do small hospitals. For many of these services, the small hospital is an unsatisfactory substitute; but there are other services which can be adequately provided at both large and small hospitals.

Optimization With a Regional Cooperative System

A widely held view in hospital planning is that hospital costs would be lower if there were greater cooperation among hospitals serving the same population in a given area. Because maximum patient demands are unlikely to occur in all hospitals at once, the census for a group of hospitals functioning as a unit or the census for a single large hospital would vary less than that for smaller independent hospitals. Therefore, fewer beds would be needed in the unit concept to provide the same level of protection as could be provided in several independent hospitals (5). As independent units, each hospital must have the capacity, in terms of staff and equipment, to handle its own maximum load. In cooperation, however, all hospitals are open to all patients and practitioners, and--in effect--they consciously avoid unnecessary duplication of services and equipment. Under a regional cooperative system, each hospital requires less staff and equipment compared with independent hospitals, because patients could be transferred to other hospitals in case of emergency demands or demands for specialized treatment.

In the Grand Traverse Region, the implications of cooperation for bed saving are demonstrated statistically by comparing expected operating rates of a fully cooperative regional system with rates expected for hospitals operating completely independently. Expectations are based on a probability analysis.

The average daily census in the region's hospitals in 1967 was 489 patients. Under the assumption that the demand for hospital facilities has a Poisson distribution and that the costs of communication and transportation among hospitals are nominal (5)(6), a single large hospital--or a group of fully cooperative hospitals--with 577 beds ($489 + 4\sqrt{489}$) would meet expected needs with the probability of .0001 that demand would exceed 577 on any given day. The expected occupancy rate would be 84.7 percent. Because the actual number of beds in the region was 611, this calculation indicates that there were 34 excess beds in 1967. If, at the opposite extreme to one large hospital or full cooperation, there were complete independence, each hospital would have to allow for overcrowding. As shown in table 2, total bed needs would rise to 702. The normal occupancy rate for the hospitals as a whole would be 70 percent.

This analysis shows that it takes 702 beds for the seven hospitals operating independently to provide the same level of service as a cooperative or single hospital's 577-bed system. With 577 beds, the OR would be 84.7 percent. The actual rate, with 611 beds, was 80 percent. Consequently, this example does use a more stringent occupancy criterion than that actually in use in the region's hospitals. 6/

6/ This analysis helps explain observed low occupancy rates in small hospitals. For example, in the 20-bed Kalkaska hospital, the average daily census was 11.7. Were it a completely isolated hospital, it would need 26 beds to guard against a .0001 probability of overcrowding. With 26 beds, the normal occupancy rate would have been 45 percent (11.7 ÷ 26).

Table 2.--Beds and mean patient days in the Grand Traverse Region's general hospitals, 1967, and beds needed if each hospital were completely independent

Hospital location	Actual beds	Mean patient days	Beds needed 1/
	Number	Days	Number
Benzie	43	34	57
Crawford	68	56	86
Grand Traverse:			
General	250	202	259
Osteopathic	73	62	93
Kalkaska	20	12	26
Leelanau	29	19	36
Wexford	128	104	145
Total	611	489	702

1/ Calculated as bed needs = $\mu + 4\sqrt{\mu}$, where μ = the mean patient census.

Nevertheless, the model is useful for its ability to demonstrate the benefits of cooperation in saving beds. As such, it can form a useful base for analysis of hospital needs, particularly those in rural areas, for they tend to have relatively more underutilized hospital beds than do urban areas. Assumptions of the model also show that the earlier analysis, based strictly on actual OR rates, contains an invalid "independence" assumption. There, the number of beds was close to actual needs. This analysis shows that if the hospitals were really independent, they would need more beds to guard against the risk of overcrowding. But, obviously, the seven hospitals are not independent; the 611 beds and 80-percent OR seem, in fact, to reflect relatively effective cooperation and to call into question the potential for improving efficiency through greater cooperation, at least in terms of reducing bed numbers. In the next section, where the Michigan State Plan estimates of bed needs are discussed, we will see how closely the hypothetical situation outlined in this section reflects the actual situation.

Optimization With a Subregional Cooperative System

Details of the approach actually planned for the region are contained in the 1968-69 Michigan State Plan. This plan is based on essentially the same patient data used in the preceding sections but uses a different method of analysis. In addition, it allows for population growth until 1973. The fundamental difference from the previously discussed independent and cooperative systems is that the plan is predicated on the needs of hospital service areas. Basically, the elements of this system are that major hospital regions--for example, the Traverse City Hospital Region--be divided into subregions, or hospital service areas, each of which must have at least one general hospital providing common services.

Four of these hospital service areas cover all of the Grand Traverse Region except part of Antrim County (fig. 1). Three of the service areas are served by a single hospital. The Traverse City service area is served by four hospitals, two in Traverse City and one each in Leelanau and Kalkaska Counties.

The number of beds existing in 1967 and the number needed to provide adequate hospital care for the population using the service areas in 1967-73 are shown in table 3. On an overall regional basis, the table shows a bed deficiency; but, in the present context of subregional service area needs, the Cadillac, Frankfort, and Grayling areas had too few beds, while the Traverse City area had too many.

In 1967, the occupancy rates in the three deficient areas were 81.2, 78.6, and 82.8 percent, respectively. Hence, while more beds need to be provided by 1973, the areas were almost optimally supplied as of 1967.

The Traverse City service area had eight excess beds, but an occupancy rate of 79.3 percent (a mere 1.7 percentage points less than the 81.0-percent occupancy rate that would have occurred had the optimum number of 364 beds been available). Bearing in mind the first section in which the finding of 10 excess beds was regarded as relatively insignificant, one can, I think, reasonably make a similar conclusion about the eight beds found here.

The need for more beds by 1973 can probably be accommodated, if the hospitals continue their cooperation with each other. Only 14 extra beds are needed to provide adequate services in the three areas outside Traverse City. If, for example, a sudden excess demand--not a major catastrophe that would affect the entire region--should occur in one or two of the four areas, the situation could be satisfied by the utilization of either or both of the hospitals in Traverse City and one in another area.

The ability to substitute among hospitals is the major bed-saving advantage of cooperative models; it is also a major disadvantage in that it causes extra traveling costs for patients, visitors, and medical personnel. 7/ However, by virtue of its geographic compactness and adequate road network, the Grand Traverse Region possesses the major physical characteristics for the implementation of a cooperative system. Furthermore, the region is served by adequate hospital facilities so that, conceptually, the system could be implemented within the framework of the existing structure, provided the full degree of needed cooperation were forthcoming.

7/ When more than one hospital is involved in the system, the extra traveling is related to the degree of cross-regional referral necessitated by the division of specialized services among the hospitals.

Table 3.--Hospital beds and occupancy rates in the Grand Traverse Region's hospital service areas, 1967, and projections for 1967-73

Hospital service area	Number of beds, 1967	Occupancy rate, 1967	Number of beds needed, 1967-73 1/
	Number	Percent	Number
Cadillac	128	81.2	134
Frankfort	43	78.6	50
Grayling	68	82.8	77
Traverse City	372	2/79.3	364
Total	611		625

1/ Bed needs are determined for each service area by the formula:

$$\text{bed needs} = \frac{\text{projected average daily census}}{80} + 10.$$

The projected census is based on current (1967) patient days weighted by expected (1973) patient days. The actual number of beds is based primarily on data in Hospitals (4) and is less than the number reported in the Michigan State Plan (3).

2/ Obtained by adding the number of patient days for the four hospitals (107,627), converting to an average daily census (107,627 ÷ 365 = 295), and expressing the results as a percentage of the number of beds (295/372 x 100) = 79.3 percent.

In summary, then, of these three analyses of hospital bed distribution, no evidence exists that the cost of hospital care in the region is increased by the presence of an excessive number of beds.

ECONOMIES OF SCALE

To turn to the second point in the discussion of the Grand Traverse Region's general hospitals: Through economies of scale, could fewer, but larger hospitals serve the region's needs more efficiently than the existing structure? The rationale for supposing such a possibility differs from that used in the preceding section. There it was shown that because the census for one large hospital or a group of cooperative hospitals varies less than for independent hospitals, the number of beds needed under the first two alternatives is less. Here we look at the slope of the long-run cost curve for the number of hospitals studied in the region.

Paul Feldstein, in a study of 60 hospitals ranging in size from 48 to 453 beds, found that for long-run adjustments to variations in patient load, the long-run average cost curve was falling throughout the whole range of hospitals included in the study (7). As a result, he was able to conclude that lower costs could be obtained if the size and output of hospitals increased. 8/ Hence, where practical and in the face of rising demand, to increase the size of existing hospitals is more economical than to build new ones.

Although the Grand Traverse Region appears to have sufficient beds to meet present and expected needs, a perspective on the efficiency of how needs are met may be gained by considering the relation between the costs and size of the hospitals along the lines suggested by Feldstein. If the region's hospitals, like the hospitals in the Feldstein study, exhibit decreasing costs, it may be possible to show that the cost of hospital care in the region exceeds that which might have been possible had, at some time in the past, a decision been made to centralize hospital facilities.

In figure 2, the total operating expense of each hospital is plotted against the number of patient days for the year 1967. 9/ While the small sample size limits the possibilities of developing statistically significant relationships from these observations, they do appear to lie in an approximately linear pattern, which agrees with Feldstein's findings. A perusal of data suggests the likelihood that a least squares line fitted to the observations would pass close to, if not through, the origin.

To check this possibility, an equation fitted to the data with an assumed zero intercept gave the following results:

$$Y = \$48.76\ PD$$
$$R = .92$$

where:

Y = total cost
PD = number of patient days

8/ Klarman (2) takes note of other studies which have found a typical U-shaped cost curve. He points out that the discrepancy between these and Feldstein's findings may result from Feldstein's removal of the influence of size on the rate of occupancy by the substitution of patient days for bed capacity.

9/ An alternative technique would have been to plot average cost per patient day against hospital size, but because size would have to include the number of services offered and the nature of the hospital as a teaching or a research institution, as well as the number of beds, it cannot be adequately represented by any one variable. And though these other variables may be correlated with the number of beds, the number of beds is highly correlated with the number of patient days (7).

THE RELATIONSHIP BETWEEN TOTAL OPERATING EXPENSE AND PATIENT DAYS IN THE GRAND TRAVERSE REGION'S GENERAL HOSPITALS

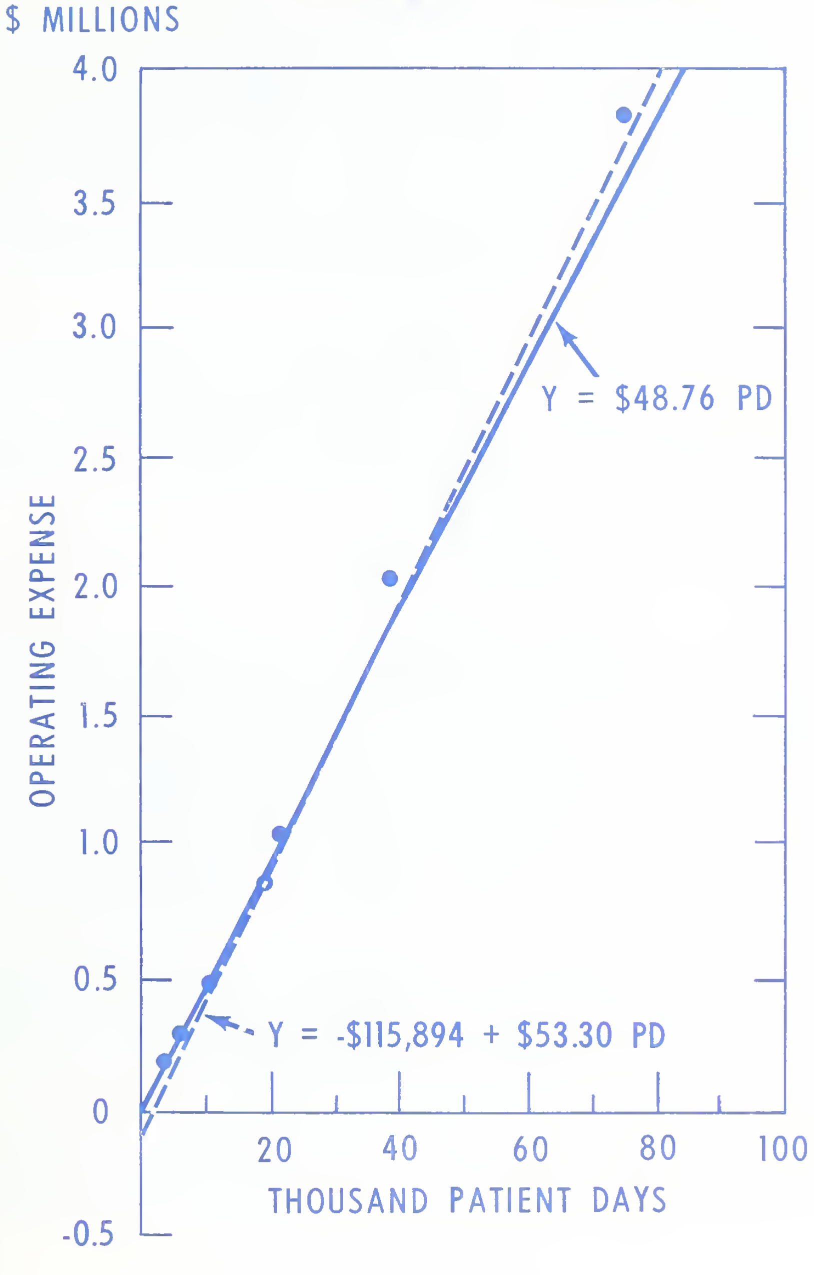

Figure 2

Because there is no constant term, marginal cost is equal to average cost. Hence, for the size of hospitals included in our sample of seven, the average cost curve is constant, and the hospitals are in the range of constant costs. 10

A nonrestricted linear equation fitted to the same data gave the following results:

$$Y = -\$115{,}894 + \$53.30\ PD$$
$$R = .99$$

This equation fits the data better than the restricted equation but suggest slightly increasing costs. The small sample and simple assumptions demand, of course, that the results of either equation be treated cautiously. Nevertheless decreasing costs are not conformable with results of other findings, including Feldstein's, about hospitals in this size range. For this reason, the first equation appears to present more realistic results and is preferred for this analysis. The equation implies constant quality of care per patient day over the range of hospital sizes. We will question this assumption in a later section.

Feldstein's study suggested some economies of scale and concluded that larger hospitals might result in some savings. The evidence based on hospitals in the Grand Traverse Region gives reason to prefer an assumption of constant costs rather than decreasing costs. There is, therefore, no basis for concluding that costs could be reduced or would have been lower had greater attention been paid to the scale of the region's hospitals.

SHORT-RUN COSTS

The previous section examined the possibility of reducing the cost of hospital care through utilizing advantages associated with economies of scale. However, the findings of constant or possibly increasing cost negated the possibility that fewer but larger hospitals could serve the region's needs more efficiently. The focus is now turned to other possibilities of reducing average costs. That is, without diminishing the quality of care, are there possibilities of short-run modifications, such as changes in production techniques or input costs, that would enable the hospitals to produce an unchanged output, but at a lower cost?

A thorough study of this question is beyond the scope of this report and would require detailed research into the operation of the individual hospitals. The emphasis here will be placed only on a general indicator, and conclusions will be made with respect to the information it provides.

The Grand Traverse Region's hospitals are classified as short-term general hospitals. Average cost per patient day in 1967 was $48.76. Under the assumptions that the hospitals are a representative sample of other general hospitals

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10/ These findings differ from Feldstein's in that he found slightly decreasing costs; nevertheless, the equation used here fits the data approximately as well as Feldstein's--the R value in each study being .92.

in Michigan and the United States and that on the average there is no difference in the quality of care, one can, by comparing regional costs and other data with that from similar hospitals, gain a rough perspective on how efficiently hospital care is provided in the region, relative to other areas. To maintain the concept of a regional hospital system serving a given population, the region's hospitals will be treated as a group. Particular hospitals will not be compared. To conclude that one hospital in the region is "better" or "worse" than another hospital in or outside the region is not possible here.

Relevant data for the region, Michigan, and the United States are given in table 4. Though the region's hospitals have approximately the same ratio of personnel to patients and the same length of patient stay as in the Nation and the State, the region's costs per patient day, payroll per patient day, and average employee salaries are below national averages, which in turn are below corresponding State averages. With employee costs accounting for over 60 percent of general hospital expenditures, it is evident that the region's hospitals, by virtue of being able to pay relatively low salaries, are able to hold average hospital costs below those in other areas.

Table 4.--Average costs, personnel, and length of stay in short-term general hospitals in the Grand Traverse Region, Michigan, and the United States, 1967

Item	Unit	Region	State	United States
Total cost per patient day	Dollars	48.76	59.22	54.08
Payroll per patient day	do.	30.09	36.64	32.44
Number of personnel per 100 census 1/	Number	264	271	265
Average salary	Dollars	4,272.00	4,941.00	4,476.00
Length of patient stay per patient	Days	8.5	8.5	8.3

1/ Census refers to the average number of patients treated on a given day.

Source: (3) and (4).

Because of, or in spite of, their rural location these hospitals have made achievements in labor and other economies. 11/ These lower short-run costs enable us to conclude in this section, too, that the Grand Traverse Region's hospital system is relatively efficient.

THE QUANTITY AND QUALITY OF HOSPITAL SERVICES

A commonly accepted norm is that a positive relationship exists between a hospital's size, measured in bed numbers, and the quantity and quality of medical services the hospital provides. The quantity of services is measured by the number of different medical functions a hospital is equipped to provide; and the quality of care is usually regarded in terms of a hospital's accreditation, medical school affiliation, training programs for interns and residents and staff qualifications, and the number and sophistication of its services. As may be expected, these quality factors tend to be associated more closely with large hospitals than with small hospitals.

The Grand Traverse Region's hospitals follow the norm in terms of quantity of services. The number of services provided ranges from two in the smallest hospital to nine in the largest (4). And, if the quality of care is related to the accreditation and affiliation factors, then there is reason for supposing that the larger hospitals are better equipped to provide quality care.

Because the larger hospitals offer more services, their costs can be expected to be higher. Figure 2 shows the larger hospitals do have higher total costs than do the smaller hospitals and as size increases, average costs increase slightly or, as we have assumed, remain constant (7). In deriving these relationships, however, no explicit allowances were made for differences in the quantity or quality of services available in different hospitals. This raises the possibility that gains from more and better services are only partially, if at all, offset by increasing costs. Were financial allowances to be made for the quality and quantity of services, total costs in hospitals of increasing size would actually increase at a decreasing rate. In this respect, then, there may be some economic as well as medical advantages to larger hospitals. Not only can they offer better quality medical care, but they can, conceptually anyway, offer it at relatively low cost, if they are big enough.

The implications of all this is that a patient who actually has a choice between a large or small hospital may implicitly discount the actual higher price of the larger hospital by an assessment of its better health care. Nevertheless, other factors, such as time and distance, can be particularly expensive for rural families. Therefore, in rural areas, it may not be practical to construct the size of hospital that has minimum average costs. There may be advantages to a network of hospitals, whereby, at least for simple disorders, adequate health care can economically be obtained.

11/ Agglomeration is not usually treated as a rural attribute, though it has apparently featured heavily in the growth of the medical complex in and around Traverse City.

In general, it is concluded that the region's population has advantages of both a large central hospital and a well distributed network of smaller facilities. While patients and their physicians appear to exhibit preferences for the large hospitals (occupancy rates are higher in the larger hospitals, table 1), the smaller hospitals are important to the operation of the whole system. Because of their geographic distribution and their lower costs, the smaller hospitals make an important contribution to the regional hospital complex's ability to provide adequate hospital care efficiently.

CONCLUSIONS

Four subjects have been covered in this appraisal of the adequacy of hospital services in the Grand Traverse Region of Michigan. The indications are that the region is served by a relatively adequate and efficiently operated network of hospital facilities. Because of its rural location, the hospital system is able to take advantage of economies such as relatively low rural wages; and by centralization of major health services, there has clearly been a medical agglomerative effect, including new services and very importantly, highly qualified personnel. The total effect is felt through the region's ability to deliver quality care at a relatively low cost.

The methods used in this analysis can be applied to other multicounty rural areas to discover possible inadequacies in hospital services and possible inefficiencies in hospital cost structures.

By using several methods, we have avoided the possibility of a bias that might easily occur were only one method used. Thus, we have gone beyond methods used by agencies to plan and evaluate regional hospital systems which may be based on one measure of, or approach to, optimum occupancy. A single measure of hospital occupancy rates usually focuses the hospital planner's or administrator's attention on achieving high occupancy. But high occupancy may have little to do with improving the quality of health care, nor is it necessarily related to economizing on the delivery of hospital services. The latter is especially apparent if high occupancy rates are used for the purpose of attracting more planning and building funds when, in fact, the situation may exist whereby greater cooperation among hospitals in a region indicates economic alternatives to increasing the number of beds.

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